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Original article

Description of immature stages of the genus *Plagiosterna* (Coleoptera: Chrysomelidae) from Korea

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ABSTRACT

Immature stages of the genus *Plagiosterna* Motschulsky are described in detail for the first time in Korea. A key for identifying larvae and pupae of Korean *Plagiosterna* is provided, along with illustrations of their habitus and larval tubercle patterns. Some remarks on their systematics are also given.

Introduction

The genus *Plagiosterna* Motschulsky, comprising over 10 species, is distributed in the Palaearctic region (Gressitt and Kimoto 1963; Kimoto and Takizawa 1994; Kippenberg 2010; Seeno and Wilcox 1982). In the Palaearctic region, 24 species have been reported; however, 14 species were synonymized, and thus, there are now 10 valid species (Kippenberg 2010). In the Korean peninsula, only two species have been recorded to date (Hong and Lee 2014). However, very little is known about the immature stages of this genus from Korea: only the larva of *Plagiosterna aenea aenea* has been briefly described and illustrated by Lee (1996), and this genus is separable from the genus *Chrysomela* in having sternal tubercles, which tend to disappear in the last instar larval stage. This characteristic feature is also applicable to the Japanese species. However, *Plagiosterna adamsi* was not applied in the diagnosis of this genus.

The purpose of this work is to provide a detailed description and illustration of tubercle patterns of all known Korean species of the genus *Plagiosterna* as the basic data for the phylogenetic study of the Chrysomelinae subfamily.

Materials and methods

The materials used in this study were preserved in 70% ethyl alcohol. Larvae and pupae were macerated in 10% potassium hydroxide solution for 30 minutes and then rinsed in water. Specimens were dissected under a stereoscopic microscope (Olympus SZX12; Tokyo, Japan). For morphological studies of the minute structure, the body parts were mounted on slides and observed through a compound microscope (Olympus SZX12; Tokyo, Japan). The terminology of setae followed in this study is basically adopted from Anderson (1947), and the nomenclature of the body tubercles follows Kimoto (1962) and Kimoto and Takizawa (1994). Numerals in parenthesis following tubercle names in the text indicate the average number of setae occurring on the tubercle. Abbreviations L, S, and M stand for long, short, and micro setae, respectively. The examined specimens are deposited in the J.Y. Park Collection, Seocheon, Korea.

In the “Systematic accounts” section, the following abbreviations are used: D: dorsal tubercle; Da: dorso-anterior tubercle; DL: dorso-lateral tubercle; Dp: dorso-posterior tubercle; e: exterior; EP: epipleural tubercle; EPa: epipleural tubercle anterior; EPai:

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epipleural tubercle anterior interior; EPp: epipleural tubercle posterior; ES: eusternal tubercle; i: interior; P: pleural region; PS: parasternal tubercle; S: sternal region; SS: sternellar tubercle; CC = coxa cavity; and tc = trochanter cavity.

Systematic accounts

Order Coleoptera
Family Chrysomelidae Latreille, 1802
Subfamily Chrysomelinae Latreille, 1802

Genus *Plagiosterna* Motschulsky, 1860
Plagiosterna Motschulsky, 1860: 196
<Type species: *Plagiosterna rufolimbata* Motschulsky, 1860>

Diagnosis. Body rather flat, length 9–12 mm in full-grown larva. Setae rather short and sparse. Tubercles distinct, pigmentation variable, D-DL-EPa and EPp type on prothorax, D and DL type on mesothorax and metathorax and abdomen. Sometimes mesothorax and metathorax with a secondary tubercle next to Da. Abdominal segments I–VI with D on both sides separated, D larger than DL, or similar in size. ad1 present, but indistinct. Defensive glands are present on DL of mesothorax and metathorax and abdominal segments I–VII. The tarsus is strongly curved with pointed tip, enlarged basally, with a seta.

Key to larvae of Korean Plagiosterna

1. Dorsal surface dark brown due to the presence of very dense chitinous plates; all tubercles pigmented; legs dark brown to brown———————————————————— *P. adamsi.*
2. Dorsal surface yellowish brown due to the presence of dense chitinous plates; the anteromedian region of prothoracic D-DL-EPa, median region of abdominal D, and sternal tubercles unpigmented; legs yellowish brown to yellowish white———————————————————— *P. aenea aenea.*

Key to pupae of Korean Plagiosterna

1. Body pale yellow and rarely with blackish patch———————————————————— *P. aenea aenea.*
2. Body pale yellow and with blackish patch———————————————————— *P. adamsi.*

Plagiosterna aenea aenea (Linnaeus, 1758) 남색잎벌레

(Figure 1)

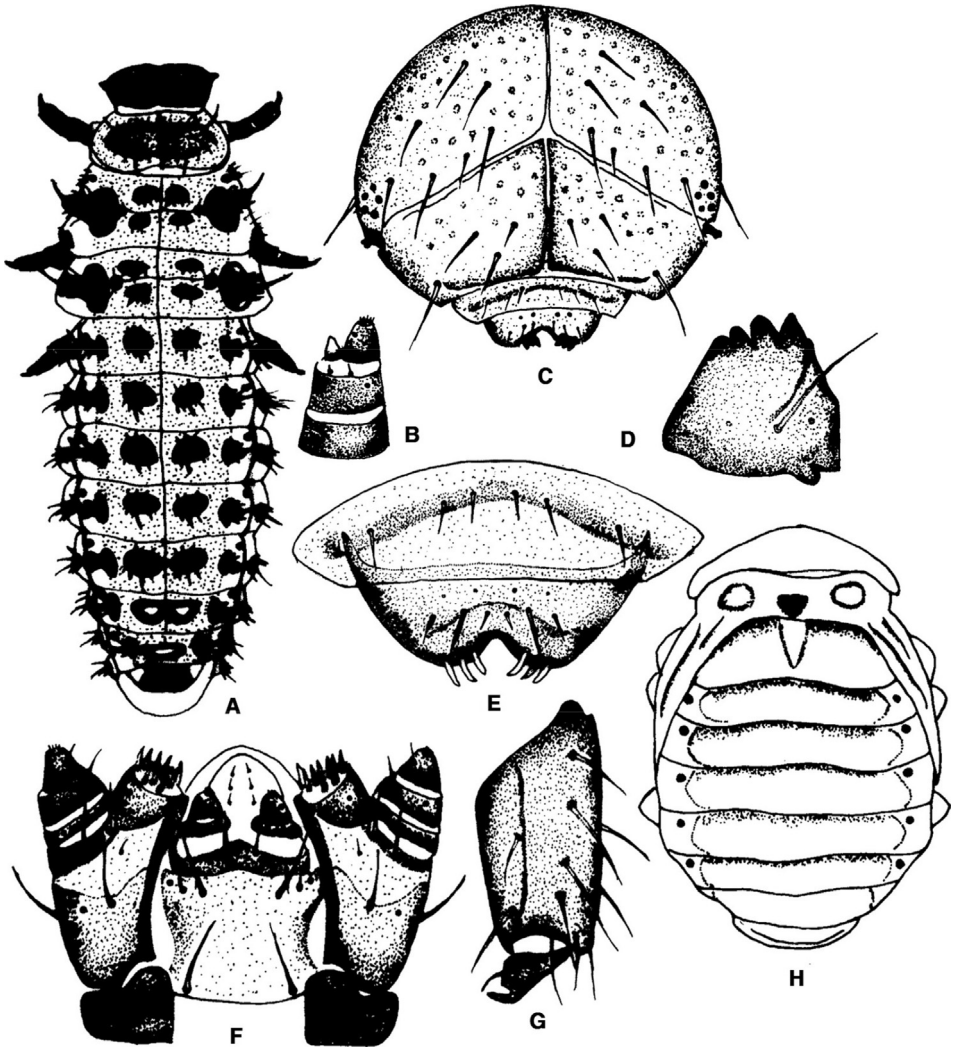

Figure 1. Habitus of immature stages of *Plagiosterna aenea aenea* (Linnaeus, 1758): A, last instar larva (l.v.); B, antenna (d.v.); C, head (d.v.); D, mandible (b.v.); E, clypeus–labrum (d.v. and v.v.); F, lower mouth parts (v.v.); G, tibia (d.v.); H, pupa (d.v.). b.v. = buccal view; d.v. = dorsal view; l.v. = lateral view; v.v. = ventral view.

Egg. Length 1.3–1.5 mm, width 0.8–1.0 mm ($n = 20$). Yellow and ovoid.

Last instar larva (Figures 1A–1G). Body length 0.8–10.0 mm, head width 1.0–1.2 mm ($n = 10$). Body yellowish white, head blackish brown, and legs yellowish brown to yellowish white. Tubercles on the dorsal surface are dark brown, but those on the anteromedian region of prothoracic D-DL-EPa-type and on the median region of abdominal D are unpigmented. Tubercles on the ventral surface are also unpigmented. Chitinous plates on the dorsal surface are strong and dense, whereas those on the ventral surface are very weak. Defensive glands are present.

Head (Figure 1C). Hypognathous, round, and slightly sclerotized. The epicranium is covered with small dark spots; frons with four pairs of setae; endocarina distinct for full length; epistomal suture is well developed. Stemmata are well developed, six in number on each side. Antenna (Figure 1B) third segmented. Clypeus (Figure 1E) trapeziform with three pairs of setae. Labrum (Figure 1E) strongly incised in the middle of the anterior margin, W-shaped, with three pairs of setae. The epipharynx (Figure 1E) has three pairs of setae. The mandible (Figure 1D) is palmate, robust, with one mandibular seta. The maxillary palp (Figure 1F) third segmented; stipes with three setae; cardo without seta; galea with 13 setae. Labial palpus (Figure 1F) second segmented; prementum with five pairs of setae; postmentum with three pairs of setae.

Thorax (Figure 3A). Dorsum with a narrow longitudinal line. Dorsal and epipleural regions of the prothorax with two tubercles [D-DL-EPa (1L, 18–22S) and EPp (3–4S)]; pleural region with a tubercle [P (2S)]; sternal region with a tubercle [ES-SS (2–4S)]. Dorsal region of the mesothorax and metathorax with four primary tubercles, namely, Da (3–5S), Dpi (1–3S), Dpe (2–3S), and DL (1L, 7–8S), and a secondary tubercle ad1 (1M), sometimes a small tubercle appears next to Da; epipleural region with two tubercles—EPa (3–6S) and EPp (1L, 3–5S); pleural region with a tubercle P (1–3S); sternal region with two tubercles [SS (1–2S) and ES (2S)]. Mesothoracic spiracles annuliform, located on EPai.

Abdomen (Figure 3A). Dorsal region with two tubercles—D (6–8S) and DL (1L, 2–3S); epipleural region with a tubercle EP (1L, 5–6S); pleural region with a tubercle P (1L, 2–3S); sternal region with two primary tubercles [PS-SS (2–3S) and ES (2S)] and a secondary tubercle as1 (1S). Seventh segments with tubercle D, which is fused on both sides. Eighth to ninth segments with dorsal and dorsolateral tubercles, which are fused. Spiracles present on segments I and II.

Remarks. According to the description provided by Kimoto (1962) on Japanese specimens, tubercles on the dorsal surface disappear in the last instar larval stage. In the Korean specimens, the tubercles on the dorsal surface, except glanduliferous tubercle (DL), disappear in the last instar larval stage. This character is consistent with those noted in European specimens (Lipp 1935).

Pupa (Figure 1H). Body yellowish brown, body length 5.0–5.5 mm ($n = 5$). Body pale yellow and with blackish patch. Setae extremely short and sparse. Seventh abdominal segment with a

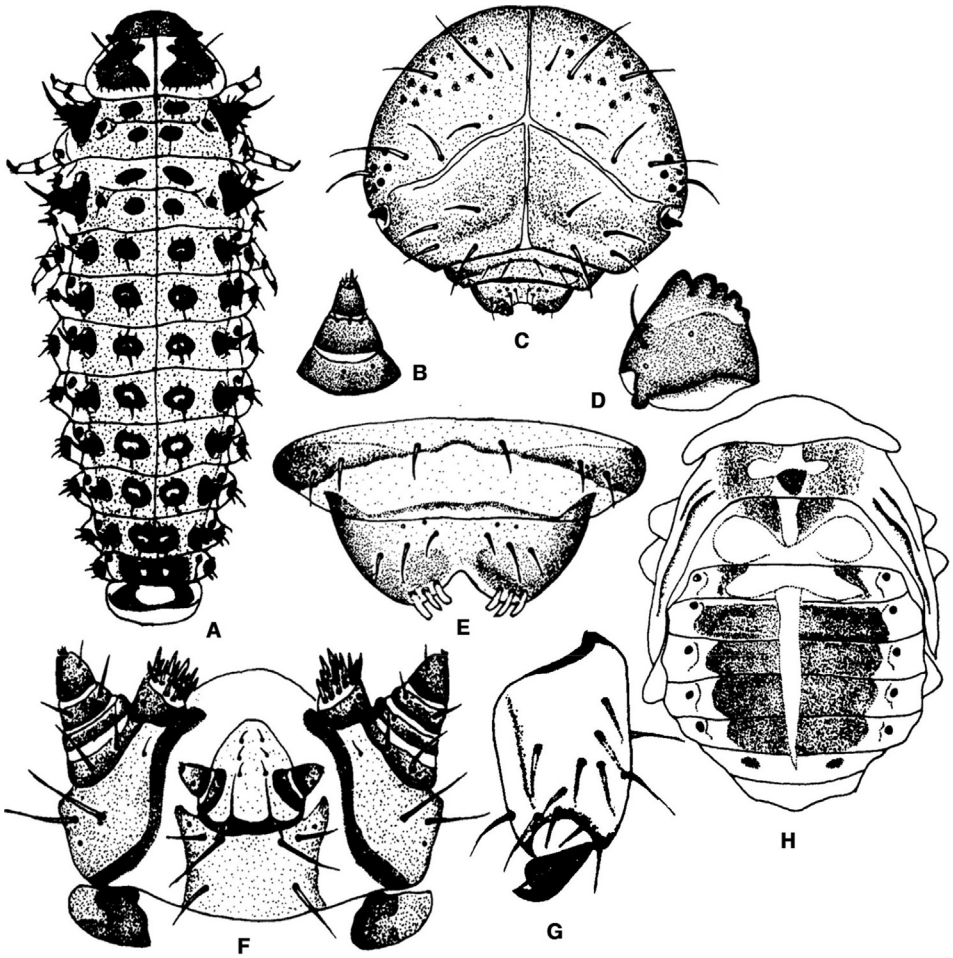

Figure 2. Habitus of immature stages of *Plagiosterna adamsi* (Baly, 1884). A, last instar larva (l.v.); B, antenna (d.v.); C, head (d.v.); D, mandible (b.v.); E, clypeus–labrum (d.v. and v.v.); F, lower mouth parts (v.v.); G, tibia (d.v.); H, pupa (d.v.). b.v. = buccal view; d.v. = dorsal view; l.v. = lateral view; v.v. = ventral view.

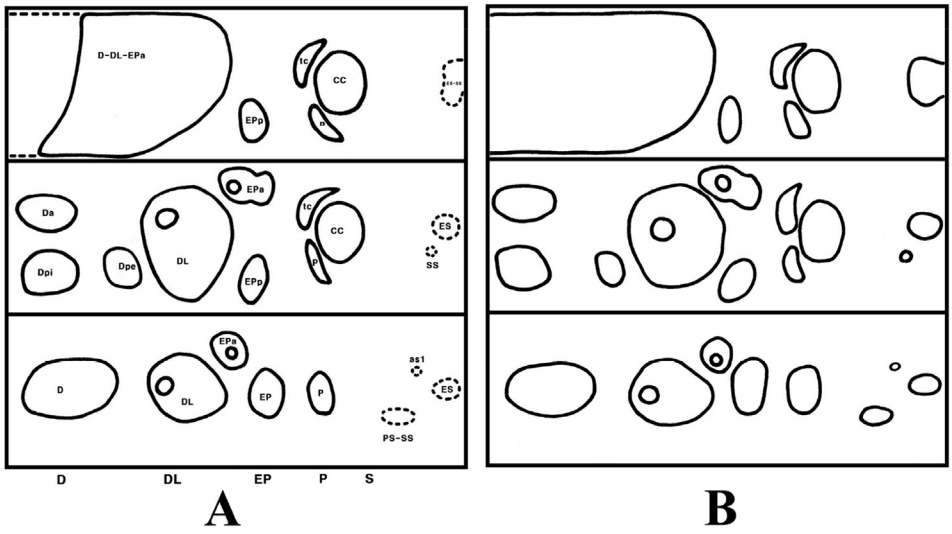

Figure 3. Schematics of the larval tubercle pattern. A. *Plagiosterna aenea aenea*; B. *Plagiosterna adamsi*. D = dorsal region; Da = dorso-anterior region; DL = dorso-lateral region; Dp = dorso-posterior region; Dpe = dorso-posterior exterior region; EP = epipleural region; EPa = epipleural tubercle anterior region; EPp = epipleural tubercle posterior region; ES = eusternal tubercle; P = pleural region; S = sternal region; CC = coxa cavity; tc = trochanter cavity.

pair of feebly raised projections laterally. Apex of ninth abdominal segment without any projection apically.

Material examined. 20 exs., Mt. Jirisan, Gyeongnam, Sancheong-gun, 23.V.2002 (J.Y. Park); 20 exs., Mt. Jirisan, Gyeongnam, Sancheong-gun, 20.V.2003 (J.Y. Park); 10 exs., Mt. Bohyeonsan, Gyeongbuk, Yeongcheon, 26.V.2004 (K.H. Kim).

Distribution. Korea, Japan, China, USSR, Europe.

Host Plants. *Alnus* spp.

***Plagiosterna adamsi* (Baly, 1884)** 참금록색잎벌레

(Figure 2)

Egg. Length 1.0–1.1 mm, width 0.9–1.0 mm ($n = 20$). Yellow, ovoid.

Last instar larva (Figures 2A–2G). Body length 10.0–10.2 mm, head width 1.2–1.3 mm ($n = 10$). Body yellowish white, head blackish brown, and legs dark brown to brown. Tubercles on the dorsal surface are blackish brown, on the ventral surface are brown and rather weak. Chitinous plates on the dorsal surface are very strong and dense, and weak on the ventral surface. Defensive glands are present.

Head (Figure 2C). Hypognathous, round, slightly sclerotized. Frons with four pairs of setae; stemmata well developed, six on each side. Antenna (Figure 2B) third segmented. Clypeus (Figure 2E) trapeziform with three pairs of setae. Labrum (Figure 2E) is strongly incised in the middle of anterior margin, W-shaped, with three pairs of setae. The epipharynx (Figure 2E) has three pairs of epipharyngeal setae. Mandible (Figure 2D) is palmate, robust, with one mandibular seta. Maxillary palp (Figure 2F) third segmented; palpifer well developed, with two setae; stipes with three setae; cardo without seta; galea with nine setae. Labial palpus (Figure 2F) two segmented; prementum with five pairs of setae; postmentum with three pairs of setae.

Thorax (Figure 3B). Dorsum with a narrow longitudinal line. Dorsal and epipleural regions of prothorax with two tubercles [D-DL-EPa (1L, 21–24S) and EPp (2–3S)]; pleural region with a tubercle P (2S); sternal region with a tubercle ES-SS (3–5S). Dorsal region of the mesothorax and metathorax with four primary tubercles—Da (4–5S), Dpi (2S), Dpe (3S), DL (1L, 7–8S)—and a secondary tubercle ad1 (1M), usually a small tubercle appears next to Da; epipleural region with two tubercles, namely, EPa (3–6S) and EPp (1L, 2–4S); pleural region with a tubercle P (2S); sternal region with two tubercles [SS (1S) and ES (2–3S)]. Mesothoracic spiracles annuliform, located on EPai.

Abdomen (Figure 3B). Dorsal region with two tubercles D (6–7S) and DL (1L, 3–4S); epipleural region with a tubercle EP (1L, 4–6S); pleural region with a tubercle P (1L, 2–4S); sternal region with two primary tubercles [PS-SS (2–3S) and ES (2S)] and a secondary tubercle as1 (1S). Seventh segments with tubercle D on both sides fused. Eighth to ninth segments with dorsal and dorsolateral tubercles fused. Spiracles present on segments I–VIII.

Remarks. The larva of this species is easily distinguished from other *Plagiosterna* larvae by entirely pigmented tubercles.

Pupa (Figure 2H). Length of body 5.0–5.2 mm ($n = 5$). Body pale yellow and rarely blackish patch. Setae extremely short and sparse. Seventh abdominal segment with a pair of feebly raised projections laterally. Apex of ninth abdominal segment without any projection apically.

Material examined. 10 exs., Andong University, Songcheong, Andong, 20.V.2001 (J.Y. Park); 40 exs., Andong University, Songcheong, Andong, 26.V.2002 (J.Y. Park); 50 exs., same locality, 20.V.2003 (J.Y. Park).

Distribution. Korea, China

Host Plants. *Alnus spp*.

Remarks. The larva of this species is easily distinguished from other *Plagiosterna* larvae by entirely pigmented tubercles.

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